Hickory for Charcoal and Fuel

by
Rufus H. Page and Lenthall Wyman

HICKORY TASK FORCE REPORT
NO. 12
DEC. 1969

In cooperation with
Southeastern Forest Experiment Station
Forest Service-U.S. Dept. of Agriculture

FOREWORD

Hickory (Carya spp.) has earned the reputation of being one of the world's toughest woods. In shock resistance it has no equal. The reputation earned by hickory is based on the performance of high-quality material in products requiring a high degree of strength and toughness.

Today, a limited quantity of high-grade hickory is available and its value and scarcity are well recognized by the wood-using industries. There is, however, a large volume of low-grade hickory that was bypassed when loggers cut our hardwood forests; and many land managers are troubled by the increasing amount of growing space occupied by it. Although this low-grade hickory does not possess the quality or properties required in many products, it is a potentially valuable wood for many uses.

A conference of federal, state, university, and industrial representatives was held in Clemson, S. C., in April 1953; and the Hickory Task Force was organized to promote the utilization of hickory. Accomplishment of this objective will be reached through research and publication of known information.

The Southeastern Forest Experiment Station has assumed the responsibility to edit, publish, and distribute reports containing information which will be developed under this program.

Full acknowledgment is due the many cooperating agencies and individuals who are making the project possible. Subject Matter Committee Chairmen are:

Joseph A. Liska, Forest Products Laboratory, Madison, Wisconsin, Growth and Properties of Hickory.
Roger Anderson, Duke University, Durham, North Carolina, Enemies of Hickory.
Roy M. Carter, N. C. State College, Raleigh, North Carolina, Manufacturing and Seasoning of Hickory.
Woodrow W. King, Tennessee Valley Authority, Norris, Tennessee, Products from Hickory.
Eric L. Ellwood, N. C. State College, Raleigh, North Carolina, Hickory for Fiber and Fuel.
Monie S. Hudson, Spartanburg, South Carolina, Treating Hickory.
Donald G. Cuppett, Forest Products Marketing Laboratory, Princeton, West Virginia, Marketing of Hickory.

Hickory for Charcoal and Fuel

by

Rufus H. Page and Lenthall Wyman[1]

Along with the population explosion, there is an increasing demand for charcoal for outdoor cooking. And with so many people living in suburbia, fireplace wood is again in demand.

Is there a preferred species of wood for either charcoal or fuel? Traditionally, we think of hickory-cured hams as the ultimate in flavor, just as we think of hickory as an excellent media for imparting warmth and comfort to the tired business man relaxing in front of an open fire. There is evidence that hickory is superior for both uses. Why?

For one reason, hickory is the heaviest of our common woods and consequently has the highest heating value per cord of all our eastern hardwoods. It also produces a high yield of superior charcoal much in demand for domestic use in outdoor grills and barbecues.

According to Timber Trends in the United States (6), the equivalent of 58.6 million standard cords of fuelwood were consumed in the United States in 1952. This figure included roundwood from growing stock and from dead and cull trees and plant by-products such as slabs and edgings. With increased use of more convenient and less expensive fuels for heating and cooking, however, this amount declined to 26.9 million cords in 1962. On the other hand, the volume of charcoal used for outdoor cooking increased from 214,484 tons in 1954 to 328,000 tons in 1961 (5).

Although an accurate breakdown by species of the volume of fuelwood used is lacking, Reynolds and Pierson estimate that hickory ranks among the six woods most burned for fuel in the East, except in the Lake States, and among the three leading fuelwood species in the South Atlantic, East Gulf, and Prairie regions (2).

---

[1]Rufus Page is in charge of Utilization and Marketing for the Division of Cooperative Forest Management, State and Private Forestry, Forest Service, U. S. Department of Agriculture. Lenthall Wyman (deceased) was for many years Professor of Forestry at North Carolina State University, Raleigh, North Carolina.

How much hickory is available for fuelwood and charcoal wood? In 1965, there was a total of 11 billion cubic feet of hickory growing stock in the United States (1). Of this total, 3.21 billion cubic feet or 43 million cords[2] was in trees from 5 to 9 inches in diameter, and 1.88 billion cubic feet or 25 million cords was in trees from 9 to 11 inches in diameter. (These are the sizes which are customarily cut for fuelwood and charcoal wood.) In addition, there was a large volume of usable wood in cull trees available for fuel.

Hickory, as well as other fuel and charcoal woods, should be air-dried before using. Wood low in moisture content requires less heat for drying and thus has a more effective fuel value. Also, dry fireplace wood weighs less, ignites more readily, and fires from dry wood are easier to tend.

Because its heartwood has a lower moisture content, shagbark hickory fuelwood requires less drying than do most hickories (1). Ash and beech, woods with similar fuel properties, also need less seasoning when used for fuel than do species such as birch, red oak, sycamore, and the gums. For faster seasoning, the wood should be stacked in open ricks and not in solid piles.

Of course, the use of wood for heating and conventional cooking has declined and will continue to decline, but it is interesting to compare the heat value of hickory fuelwood with that of other woods and coal (table 1).

There is little difference in heating value between the various species of hickory. If shagbark hickory is rated as having a heating value of 1, the other hickories have the following relative values (4):

Species	Relative heating value
Shagbark	1.00
Pignut	1.02
Mockernut	1.00
Shellbark	.98
Bitternut	.98
Water	.97
Pecan	.96
Nutmeg	.87

For purposes of comparison, a cord of air-dry hickory has the same heating value as 1.12 tons of bituminous coal (table 1) or 175 gallons of fuel oil or 24,600 cubic feet of natural gas.[3]

[2]Based on 75 cubic feet per stacked cord of unpeeled roundwood.

[3]Based on heating values of 135,000 B.t.u. per gallon for fuel oil and 1,000 B.t.u. per cubic foot for natural gas.

Table 1.--Approximate air-dry weight and heating value per cord of some woods[1] (1)

Species	Weight	Available heat	Equivalent in coal
	Pounds	Million B.t.u.	Pounds
Hickory, shagbark	4,240	24.6	2,240
Ash	3,440	20.0	1,820
Aspen	2,160	12.5	1,140
Beech, American	3,760	21.8	1,980
Birch, yellow	3,680	21.3	1,940
Elm, American	2,960	17.2	1,560
Maple, red	3,200	18.6	1,700
Maple, sugar	3,680	21.3	1,940
Oak, red	3,680	21.3	1,940
Oak, white	3,920	22.7	2,080
Pine, eastern white	2,080	12.1	1,200

[1]In table 1 it was assumed that there are 80 cubic feet of solid wood per cord, that air-dry wood contains 20 percent moisture content in terms of ovendry weight, that all hardwoods produce 5,800 B.t.u. per pound of wood, and that coal will produce 11,000 B.t.u. per pound.

In addition to its use as fuelwood, hickory is one of the most economical woods for producing charcoal. The number of pounds of charcoal yielded from a cord of wood is directly related to the density of the wood used. Although the buyer gets about the same heating value per pound of charcoal regardless of species, the producer usually buys wood by the cord and sells charcoal by the pound. Because of hickory's high density in comparison to that of other native hardwoods, it produces more charcoal per cord than do these lighter woods (table 2).

Table 2.--Relationship of wood density to charcoal yields[1]

Hardwood species in order of density	Runs	Charcoal yield	
		Lb. per cord	Percent
Light hardwoods	3	670	30.9
Southern red oak	16	820	29.6
Mixed oak and hickory	11	850	29.2
Hickory	1	920	27.9

[1]Adapted from "Charcoal Production, Marketing, and Use," p. 92, U. S. Forest Serv. Forest Prod. Lab. Rep. 2213, 1961. Averages in the table are based on runs in a 7-cord masonry block kiln.

How does hickory fuelwood compare with hickory charcoal in heating value? Wood loses about 75 percent by weight and 50 percent by volume in the charring process. Thus, a cord of air-dry hickory should make about 1,000 pounds of charcoal, although yields are usually less than this even in efficient kilns. Risa (3) reports that, regardless of species, charcoal produces an average of 13,300 B.t.u. per pound. A cord of hickory wood has a heating value of 24,600,000 B.t.u. (table 1). If we accept 13,000 B.t.u. as the average heating value of a pound of charcoal, then the 1,000 pounds of charcoal per cord of hickory would produce 13 million B.t.u.--or about half the heating value of a cord of hickory wood.

This type of beehive charcoal kiln holds $\frac{1}{2}$ cord of wood and, being composed of three sections of sheet metal, is fully portable. Developed in the 1930's, these kilns, seen here in the coaling phase, are still widely used.

Many persons prefer hickory wood for outdoor cooking because of the flavor it imparts to food. Charcoal made from hickory, however, has no special flavor except in the minds of "hickoryites," because the volatiles in the wood are driven off in the process of making charcoal and most of what remains is carbon. Outdoor grill cooks who like the flavor of hickory smoke put hickory sawdust, shavings, or small blocks of wood on their charcoal fires to obtain the characteristic flavor. These blocks are usually trimmings from blanks used to make tool handles, ladder rungs, picker sticks, skis, and other products. Meat packers also provide a market for hickory sawdust, shavings, and blocks for smoking products such as hams, bacon, sausage, and some cheeses.

Many hickories are not suitable for making specialty products because of poor tree form or other defects. Such low-quality hickories, however, are unsurpassed for use as fuelwood and charcoal, even though these two products do not command as high a value as do most other wood products. In addition, when such trees are removed and utilized, the landowner and the processor benefit and the timber stand is improved.

LITERATURE CITED

(1) Hall, Robert T., and Dickerman, M. B.
1942. Wood fuel in wartime. U. S. Dep. Agr. Farmers' Bull. 1912, 22 pp.

(2) Reynolds, R. V., and Pierson, A. H.
1942. Fuel wood used in the United States 1630-1930. U. S. Dep. Agr. Circ. 641, 20 pp.

(3) Risa, Jos.
1942. L'Industrie de la carbonisation du bois, dans la province de Quebec. Serv. Forest. Bull. (Nouv. Ser.) 3.

(4) USDA Forest Service
1919. The use of wood for fuel. U. S. Dep. Agr. Bull. 753, 40 pp.

(5) ________
1963. Charcoal and charcoal briquette production in the United States, 1961. USDA Forest Serv. Div. Forest Econ. and Marketing Res., 33 pp.

(6) ________
1965. Timber trends in the United States. USDA Forest Serv. Forest Resource Rep. 17, 235 pp.

Open-door firing of a 7-cord cinder block charcoal kiln loaded with hardwoods.
(Photo by Georgia Forestry Commission.)

HICKORY REPORTS PUBLISHED

Hickory for Veneer and Plywood
Chemistry of Hickory
Fungus Enemies of Hickory
Seasoning Hickory Lumber and Handle Blanks
The Distribution and Volume of Hickory Timber
Products from Hickory Bolts
Grading and Measuring Hickory Trees, Logs, and Products
Seasoning and Preservative Treatment of Hickory Crossties
Nails and Spikes in Hickory
Silvical Characteristics of the Commercial Hickories
Steam Bending of Hickory
Hickory for Charcoal and Fuel

HICKORY REPORTS PLANNED

Damage to Hickory by Insects and Birds
Finishing Hickory
Gluing Hickory
Hickory for Fiber
Logging and Milling Problems with Hickory
Machining Hickory
Managing Hickory in the Hardwood Stand
Marketing of Hickory
Mechanical Properties of Hickory
Products Obtained from Hickory Logs
Stresses in Living Hickory and Their Importance

Copies of the Hickory Task Force publications can be obtained from the following:

Southeastern Forest Experiment Station
P. O. Box 2570
Asheville, North Carolina 28802

Southern Forest Experiment Station
T-10210 Federal Building
701 Loyola Avenue
New Orleans, Louisiana 70113

North Central Forest Experiment Station
Folwell Avenue
St. Paul, Minnesota 55101

Northeastern Forest Experiment Station
6816 Market Street
Upper Darby, Pennsylvania 19082

Forest Products Laboratory
North Walnut Street
Madison, Wisconsin 53705

Regional Forester
U. S. Forest Service
50 Seventh Street, NE.
Atlanta, Georgia 30323

Regional Forester
U. S. Forest Service
633 W. Wisconsin Avenue
Milwaukee, Wisconsin 53203

Forest Utilization Section
Tennessee Valley Authority
Norris, Tennessee 37828

8